

they were making considerable noise, uttering a variety of strange notes, many of which were subdued and conversational. When it was quite dark I crept on hands and knees into the woods, which consisted mainly of young oaks, to within about forty feet of the Crows, when suddenly one sounded an alarm, and the others flew from the low trees without uttering a sound. They lit only a few yards away, but scattered in their flight, and the Crow who did the cawing lit in the next tree from that used as a roost.

The Annadale woods was visited on the 11th of December, 1892, and on the 23d of December, 1893, for the purpose of observing whether the Crows frequented them at that season, but though a few flew by, all were found to be on their way to New Jersey.

It will be seen from the above that Crows visit Staten Island in winter from two, and sometimes in severe seasons, from a third New Jersey roost, and that in summer they occupy principally two warm weather roosts on the island itself.

THE DISTRIBUTION OF GENERA AND SPECIES OF NON-MIGRATORY LAND BIRDS IN THE PHILIPPINES.¹

BY J. B. STEERE.

IN THE years 1887 and 1888 a party from the University of Michigan visited the Philippines for the purpose of scientific exploration. During this visit several important facts relating to the distribution of birds in these islands were noticed. As one island after another was explored, it was found, as was to be expected, that most of the genera of birds were continually recurring, thus giving a general similarity to the bird fauna of all the islands.

¹ Read before the American Association for the Advancement of Science at Indianapolis, August, 1890.

Each genus was ordinarily represented by but a single species in a place, so that the number of species and the number of genera in any one locality were nearly equal. This resulted from the fact that in a large number of genera the islands possessed but a single widely distributed species of each, and that in a large number of other genera, though each genus existed in the islands in several species, each of these species occupied a limited area of its own made up of one or more adjacent islands. In this limited area it existed by itself, sharply separated from the other species of the same genus.

This reappearance of genera in new specific forms in each distinct area was so frequent with a large number of them that the members of the party learned to expect and to look for local species of these whenever a new island was reached.

On making a study of the distribution of the genera and species of birds collected by the party in these islands on our return to the United States, the facts above noticed were found to be further reaching and of more importance than was at first supposed, and to point to a law of distribution which, if established, must have great influence upon the theories for the creation of species.

In this study only the collections made by the members of the party have been used. Great care was taken with these in noting the exact place of collection, sex, color of eyes, etc., while with many collections formerly made from the islands it was supposed sufficient to label them as from the Philippines.

About five thousand specimens of birds were collected by the party, belonging to nearly or quite four hundred species. These were collected on seventeen distinct islands of the group, which were chosen from their size and location as representative of the whole.

These collections, while not comprising all species known from the islands, are so nearly complete that any just conclusion drawn from their study must be accepted as truth, which further exploration will only strengthen.

The general arrangement followed has been that of Lord Walden and of Prof. R. B. Sharpe, in their published lists of Philippine birds. The names of genera and species have been made to agree generally with those given in the 'Catalogue of

the Birds of the British Museum,' as far as the volumes of that work had been issued when this paper was first prepared.

The land birds of the Philippines collected by the expedition, as far as identified, belong to one hundred and fifty-six genera, and number three hundred and twenty-four species.

Of these, six genera (List A), — *Lanius*, *Motacilla*, *Anthus*, *Locustella*, *Acrocephalus*, and *Phylloscopus*, — with twelve species, are migratory as regards part or all of their species found in the Philippines, and have been left out of the study, though the non-migratory species of these seem to be distributed according to the same law governing the other resident birds.

There are left one hundred and fifty genera and three hundred and twelve species of resident land birds. Of these, seventy-five genera were found represented in the Philippines by single species each. These are as follows:—

LIST B.

Cacatua	Chrysococcyx	Copsychus
Accipiter	Hierococcyx	Climacteris
Lophotriorchis	Dasylophus	Chalcostetha
Spizaetus	Lepidogrammus	Corone
Pernis	Pyrrhocentor	Acridotheres
Butastur	Dryococcyx	Calornis
Haliaetus	Anthracoceros	Sturnia
Haliastur	Artamus	Sarcops
Elanus	Lalage	Gracula
Microhierax	Buchanga	Padda
Pandion	Muscicapa	Mirafra
Polyoaetus	Rhipidura	Passer
Bubo	Eumyas	Treron
Scops	Culicicapa	Carpophaga
Strix	Pratincola	Myristicivora
Tiga	Abrornis	Ptilocolpa
Harpactes	Cryptolopha	Hemiphaga
Eurystomus	Xanthopygia	Ianthænas
Alcedo	Dasyrotropha	Chalcophaps
Macropteryx	Dendrobiastes	Calænas
Chaetura	Egithina	Geopelia
Batrachostomus	Micropus	Gallus
Lyncornis	Merula	Megapodius
Cacomantis	Monticola	Excalfactoria
Chalcococcyx	Geocichla	Turnix

These are, to a great extent, large and long-winged species of Hawks, Owls, Cuckoos, Starlings, Pigeons, etc., which may pass readily from island to island; a number being extended over the whole archipelago, and some species reaching the adjacent countries. A few of them are Bornean genera, apparently lately introduced into Paragua, which have not had time to become more widely distributed through the archipelago, and in some cases have hardly as yet formed distinct species. Examples of these are *Pernis*, *Tiga*, *Buchanga*, *Ægithina*, and *Gracula*. A few are Philippine genera, differentiated as yet into single species only, or having formerly existed in more species they have been reduced to their present state by the great changes of area and other conditions to which the islands are subject. Such are the genera of Cuckoos, *Lepidogrammus*, *Dasylophus*, and *Dryococcyx*, the Starling *Sarcops*, and the curious Timeline form *Dasycrotopha*. It is probable that a few genera of this list, among them *Scops*, *Batrachostomus*, and *Megapodius*, will be found to have more than one species in the islands. In this case they will fall into List C, and will in no sense weaken the conclusions of this paper.

In fifty-three genera, with one hundred and fifty-three species, each genus is represented in the Philippines by two or more species, each of which exists in a limited area of its own, sharply separated by sea channels from the similar areas occupied by the other species of the same genus.

These genera, with the number of species of each found occurring in the archipelago, are as follows:—

LIST C.

Prioniturus, 4.	Xanthokæma, 2.	Hyloterpe, 4.
Cyclopsitta, 2.	Caprimulgus, 2.	Pericrocotus, 2.
Loriculus, 7.	Surniculus, 2.	Dicrurus, 4.
Spilornis, 3.	Eudynamis, 2.	Siphia, 2.
Falco, 2.	Centrococcyx, 3.	Philentoma, 2.
Thriponax, 4.	Buceros, 3.	Zeocephus, 3.
Mulleripicus, 3.	Craniorrhinus, 2.	Setaria, 2.
Chrysocolaptes, 5.	Penelopides, 6.	Broderipus, 2.
Yungipicus, 4.	Artamides, 5.	Oriolus, 4.
Pelargopsis, 2.	Edoliisoma, 3.	Erythropitta, 2.
Actenoides, 3.	Pseudolalage, 2.	Macronus, 2.

Mixornis, 3.	Parus, 2.	Corvus, 2.
Ptilocichla, 3.	Sitta, 2.	Sarcophanops, 2.
Chloropsis, 2.	Zosterops, 4.	Oxyerca, 3.
Irena, 4.	Prionochilus, 3.	Munia, 2.
Poliolophus, 4.	Æthopyga, 4.	Macropygia, 2.
Pycnonotus, 2.	Arachnothera, 2.	Phlogœnas, 2.
Cittocincla, 3.	Anthothreptes, 2.	

Future observations will probably remove *Falco* from this list to the one which follows. Professor Sharpe does not recognize the genus *Broderipus* in the Oriolidæ, nor the genus *Actenoides* among the Kingfishers. If these genera are thrown out the species placed under them will also fall into the following list. Several of these genera, among which are *Caprimulgus*, *Surniculus*, *Eudynamis*, *Erythropitta*, *Pycnonotus*, *Parus*, and *Sitta*, possess but two Philippine species each, one of which inhabits the islands of Paragua and Balabac on the west, while the other species is quite generally distributed over the remaining islands.

Perhaps one of the most characteristic genera of List C is *Loriculus*, the small, green, blue-winged and red-rumped Parrots. This genus exists in seven species, which have the following distribution: *L. philippensis* occupies the islands of Luzon and Marinduque; *L. regulus* the islands of Panay, Guimaras, Negros and Masbate; *L. mindorensis* the island of Mindoro; *L. chrisonotus* the island of Cebu; *L. worcesteri* the islands of Samar and Leyte; *L. siquijorensis* the little island of Siquijor; and *L. hartlaubii* the islands of Mindanao and Basilan. The western islands or Paragua and Balabac seem to lack the genus altogether. Though some hundred and fifty specimens of this genus were procured, in no case were individuals of two species found inhabiting the same island, though the straits separating islands were in some cases very narrow. This is notably so with the islands of Negros and Cebu, occupied respectively by *L. regulus* and *L. chrisonotus*. These islands approach each other so closely at the straits of Dumaguete that the outlines of houses and trees can be readily made out across them.

The genus of small Hornbills, *Penelopides*, with six species, is another good example of the method of distribution of species in this list. *Penelopides panini* inhabits Guimaras, Panay,

Negros, and Masbate; *P. manillæ*, Luzon and Marinduque; *P. affinis*, Mindanao; *P. basilanica*, Basilan; *P. samarensis*, Samar and Leyte; and *P. mindorensis* the island of Mindoro. The western islands seem to lack this genus also.

In seventeen genera, with seventy-four species, each genus is represented in the islands by several species: two or more of which may be found inhabiting the same island; but the species thus found together, with the same generic name, differ greatly in size or coloring or other structures and belong to different natural sections or subgenera.

These sections or subgenera themselves may each be represented in the archipelago by several species; but where this occurs each species is found isolated and separated from all the other species of the same subgenus, just as are the species of the genera given in List C. These genera, with the number of species of each, are the following:—

LIST D.

Astur, 2.	Hypothymis, 4.	Cinnyris, 7.
Ninox, 4.	Cyanomyias, 2.	Ptilopus, 3.
Merops, 2.	Hirundo, 3.	Phabotreron, 6.
Ceyx, 6.	Iole, 6.	Osmotreron, 2.
Halcyon, 5.	Orthotomus, 8.	Turtur, 2.
Collocalia, 2.	Dicaeum, 10.	

Authors have already attempted in several cases to raise the natural sections of these genera to generic rank.

Whenever the birds of two sections of one of the genera named above differ greatly in size, the species of the section of larger, longer-winged birds will be more widely distributed than the smaller birds of the other; one of the larger species being able to extend itself over the areas of several of the smaller forms. The genus *Ninox* is an example of this. *Ninox lugubris*, a large, long-winged, long-tailed form, seems to be distributed over the whole archipelago, while the other section of smaller, short-tailed birds, of which *Ninox philippensis* is an example, contains at least three species, — one found in the south, one in the central islands and the other in Luzon. The genus of Ground Pigeons, *Phabotreron*, is another example of this method of dis-

tribution, the larger, *Phabotreron amethystina*, apparently extending over the areas of the other five smaller species.

The distinct conditions under which these subgenera exist together were frequently apparent even in our hurried visit. The species of Bee-birds, *Merops*, were quite closely observed. The two species, *M. bicolor* and *M. philippinus*, probably exist together on every island of the group. *M. bicolor* is social, hundreds sometimes feeding together, in groves and forests, at a height of fifty to a hundred or more feet from the ground. They appear to be closely limited to honey bees as food. They were found nesting semi-socially in dry, nearly level ground, into which they burrowed several feet. This was in the island of Marinduque in May, 1888. *M. philippinus* is solitary in habit and feeds near the ground in open country, where it perches on posts and on bushes. Its food, as far as observed, was wasps and dragon-flies. It was not observed nesting.

The species of the genus *Ceyx* were found to vary greatly in their habitat. There were the woodland Ceyxes, *Ceyx melanura* and its allies, always found away from the streams and in the forests, and the river Ceyxes, *C. cyanopectus* and *C. argentata*, as universally found along the streams.

Three species, of three subgenera, of so-called *Halcyon* were found generally distributed over the islands together. These were *H. gularis* (Entomobia); *H. coromanda* (Callialcyon); and *H. chloris* (Sauropatis). None of these frequented the water; *H. gularis* being found in open plains feeding from the ground, or perched in low trees; *H. coromanda* in low, thick undergrowth in forests, and *H. chloris* quite generally near the sea beach and often in open coco groves about the coast villages.

The maroon-backed *Osmotreron* is arboreal, feeding in the high trees in flocks. *Osmotreron vernans*, on the other hand, inhabits thickets, where it feeds from the bushes or the ground, and is found singly or in pairs.

There remain five genera and ten species in which two species of the same genus were found existing together in the same islands, these not differing enough to appear to warrant placing them in distinct sections of the genus.

These genera, with the number of species of each found in the islands, are the following:—

LIST E.

Melanopitta, 2.

Megalurus, 2.

Tanygnathus, 2.

Criniger, 2.

Cisticola, 2.

Even here there seems to be no case in which the two species of the same genus found existing together are so closely allied that they may be supposed to have been derived from a common form in the area in which they now occur. They usually differ considerably in size or coloring, and in the case of *Cisticola* and *Megalurus*, the only genera in which both of a pair of species were observed, there was a sharp distinction of habitat noticed. *Cisticola exilis* inhabited the low, open, level rice fields of Luzon, and *Cisticola cisticola* the wooded hills. *Megalurus ruficeps*, where it occurred with *M. palustris*, was found in the waste places inland, which had grown up to high, coarse grass, while *M. palustris* was found close along the beach in open grassy places.

The relative abundance of the two species is worth noting in the case of *Melanopitta* and *Tanygnathus*. *Melanopitta sordida* is the common form found everywhere and always abundant, while of *M. steerii* our party found but one specimen in Mindanao in a six weeks' stay, and another in Samar. *Tanygnathus luconensis* again is the common form found everywhere abundantly, while but a single specimen of *T. everetti* was ever seen. Our collections seem to show that *Melanopitta sordida* occurs alone through most of the islands, but with *M. steerii* in Mindanao and Samar; also that the large *Megalurus palustris* alone occupies the northern and western islands, the smaller species, *M. ruficeps*, the central islands, while the two species inhabit Marinduque together.

It seems probable that *Melanopitta* and *Tanygnathus* are examples where two species of a genus, after having arisen in different areas, have then been thrown together after they have just come to differ too much to fuse, while they still remain almost identical in habits and foods, and so are brought into such conflict that the weaker species is disappearing.

Putting Lists B and C together, there are one hundred and twenty-eight genera out of one hundred and fifty, and two hundred and twenty-eight species out of three hundred and

twelve, in which each genus is represented by but a single species in a place. This is about thirteen-fifteenths of the whole number of genera and five-sevenths of the whole number of species; altogether too great a proportion of both to have no significance.

If we add to Lists B and C List D, there results one hundred and forty-five genera out of one hundred and fifty, and three hundred and two species out of three hundred and twelve, or twenty-nine from every thirty of the genera and over thirty from every thirty-one of the species so distributed in the islands that no two species nearly enough allied to be put in the same section or subgenus are found existing in the same island. These three lists teach the same law of distribution, and the difficulty in formulating it is not in the facts but in the necessary imperfection of the terms used in measuring the values of the various natural groups of animals. The fact that these natural groups vary in value indefinitely makes it forever impossible to so measure them by the fixed rule of species and genus that all men shall be agreed.

The law of distribution of non-migratory land birds of the Philippines may be stated as follows:—

The genus is represented by but a single species in a place.
Or, in more general terms, as follows:—

No two species near enough alike structurally to be adapted to the same conditions will occupy the same area.

The varieties or subspecies of birds in the Philippines, wherever observed, follow the same law of distribution as the species; the varieties of a species, if any, each existing in neighboring but distinct areas. The great Bronzed Pigeon, *Carpophaga aenea*, has the bronzed shading of the back much deeper in the specimens from Basilan than in those from the central and northern islands, while those from Paragua have the wings much bluer in color. The Red Woodpecker, *Chrysocolaptes xanthocephalus*, from the central islands, has more red on the throat in the bird from Masbate than in the one from Panay and Negros. The Cockatoo and Racquet-tailed Parrot of Mindanao are decidedly smaller than the same species in the other islands. Other examples of the same kind are numerous, and there appears to be a tendency in every species to form as many varieties as it

inhabits distinct islands with separating sea channels broad enough to make the passage over difficult and infrequent.

The above facts make Philippine species and varieties geographical or local groups depending upon local causes for their existence. They show *isolation* to be the first and the necessary step in the formation of species.

The foregoing facts make the belief in the fusion of closely allied species, when thrown together, almost necessary. The volcanic character of the islands and the shallow seas separating them, with the observed marks of frequent changes of sea level, make it necessary to believe that the land areas of the Philippines have been continually varying and that, in multitudes of cases, closely allied species have been thrown together by the connection of islands formerly distinct. These closely allied species now no longer existing together, they must have disappeared either by the destruction of one or by their fusion. To one who has observed the likeness in size and coloring and notes and food of these allied forms, the latter is the only reasonable hypothesis for the greater number of cases.

A satisfactory explanation of many or most of the phenomena of distribution of genera and species in larger and continental areas may be found in giving the same prominence to isolation and fusion in the formation of the species occupying them.

RECENT LITERATURE.

McIlwraith's Birds of Ontario.¹—The first edition of Mr. McIlwraith's excellent manual, 'The Birds of Ontario,' published in 1886 (see Auk, IV, 1887, p. 245), was speedily exhausted, so that for some years past the

¹ The | Birds of Ontario | being a concise account of every Species of Bird | known to have been found in Ontario | with a | Description of their Nests and Eggs | and Instructions for collecting Birds and preparing | and preserving Skins, also Directions how | to form a Collection of Eggs | By Thomas McIlwraith | Member of the American Ornithologists' Union | — | Second Edition—Enlarged and Revised to Date | With Illustrations | — | Toronto | William Briggs, Wesley Buildings | Montreal : C. W. Coates Halifax : S. F. Huestis | MDCCCXCIV—8vo., pp. i-x, 11-426.